U.S. ARMY

INTRODUCTION

The Army awarded over 800 contracts as a result of the last three years' solicitations. As a result, approximately 350 projects are planned for conversion to Phase II, which will require most of the fiscal year 1989 funds. As a consequence, the Army portion of this year's solicitation is greatly reduced compared with previous years.

SBIR proposals must be prepared with care. Read the topics carefully and respond only to those in which you have expertise. Your proposal should be unique and innovative and should contain sufficient detail to permit a determination that the Army's support would be worthwhile and that the proposed work could benefit the Army's research and development or other mission responsibilities. Take care to observe the page limits, the due date, and the proper mailing address (see following pages).

Inquiries of general nature or where a problem may exist that requires the Army SBIR program manager's attention may be addressed to -----

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In no case should proposals be sent to the above address.

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1989

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ARAMENT RDE CENTER

A89-001 TITLE: Advanced Seekers for Smart Munitions

OBJECTIVE: Develop new and improved smart munitions seekers.

DESCRIPTION: The U.S. Army Research, Development and Engineering Center (ARDEC) has committed itself to developing an evolutionary family of both “shoot to kill” as well as “hit to kill” smart projectiles munitions throughout the foreseeable future. Past examples of this thrust are seen in the copperhead projectile currently in production, as well as search-and-destroy armor (SADARM) now in full-scale development. Seekers and sensors in future munitions will be faced with increasingly complex decision making situations, and they must also be producible, affordable, and packageable into existent envelopes of constraint.

These munitions will rely on increasingly autonomous seekers capable of finding a variety of ground and air targets immersed in terrain/background situations. Infrared (IR), millimeter wave (MMW), and laser technologies form the conventional baseline approaches. In addition, acoustic stream of signals representing space-time maps of the world, at state-of-the-art resolution levels. Present seekers are limited in their performance against complex backgrounds, weather adversities, and counter-measures, and their performance must be enhanced. Examples are hybrid semi-active laser (SAL/infrared (IR) seekers, focal plane array/imaging IR seekers, strapdown IR/MMW seekers, advanced MMW integrated circuit seekers, and dual mode IR/MMW seekers.

ARDEC is also interested in cost and producibility issues involving the above and: uncooled IR detectors, longwave IR focal plane arrays, low-cost optical trains, ruggedness of IR/optical components, conformal phased antenna arrays, signal-processing hardware, high repetition rate laser diodes, and tunable/switchable IR filters.

The pattern-recognition challenge goes hand in hand with the hardware challenge. The seeker must detect, identify, classify, and track the desired target(s) in an unpredictable and complex set of data. To make this feasible, hardware advances in large-scale integrated circuits (LSIC), optical computers, and parallel-processing architectures must be tied together with advances in algorithms and artificial intelligence disciplines.

CHEMICAL RDE CENTER

A89-002 TITLE: Sorbents for Decontamination of Chemical Warfare Agents

DESCRIPTION: Of the technologies evaluated in the Army Decontamination Master Plan, sorbents offered the greatest promise for operational advantage to the individual soldier in the field. At the moment many countries in the world have as standard small decontamination kits some variant of sorbent technology. Fuller’s earth or diatomaceous earth are the most common. The US, however, does not now have a sorbent-based kit. The reasons for that are many. Sorbents have limited capacity, typically 25% by weight or less of liquid chemical agent can be absorbed, and provide no destruction of the agent. As a consequence, the used material is hazardous itself and clean-up of large amounts of liquid requires much material.

Thus, sorbents or solids are required that will react with the chemicals they absorb. Ideally this reaction should be catalytic so that little sorbent would be required to destroy the agent; this opens the possibility of materials that could be reused, thereby reducing the logisitic impacts. To be useful the sorption must be fairly fast to pick up the liquid quickly. The reactions could then proceed at a somewhat slower pace if, when they were complete, the surface would be ready to absorb more agent.

Phase I objectives will concentrate on identifying candidate sorbents to meet Army requirements. Those sorbents identified in Phase I will be evaluated in Phase II individually and in conjunction with catalytic materials.

AVIATION SYSTEMS COMMAND

A89-003 TITLE: Rotocraft Tactics Expert and Mission Management System

DESCRIPTION: Automated systems using artificial intelligence (AI) techniques are currently needed to stimulate advanced in-flight pilot decision aiding concepts in research environments such as the NASA/Army Crew Station Research and Development Facility. Such intelligent decision aiding systems are a recognized requisite for mission's effectiveness in advanced Scout/Attack helicopters such as LHX. They are envisioned to provide the pilot or crew with on-board planning, situation awareness, tactics and systems- monitoring advisory capabilities. In addition, these knowledge-based systems are required to interface with advanced cockpit displays and controls as to allow pseudo-natural dialog by means of interferences about the pilot's intent. Areas requiring innovative research include: (a) Development of a cooperative knowledge based systems structure to support simulation of on- board tactics expert, situation awareness, and other mission-management functions. (b) Development of an intelligent pilot-vehicle interface concept predicated on a knowledge base of the helicopter pilot's intentions and natural language techniques. (c) Development of mathematical and logical structures for representing multi-attribute resource values and mission objectives to support planning, tactics expect or situation awareness functions in a combat threat environment. Phase I will involve a detailed study effort and prototype development. Phase II will provide a working version of the concept that will allow fully integrated use within the NASA/Army Crew Station Research and Development Facility.

A89-004 TITLE: Fatigue Life Monitor (non-airframe)

DESCRIPTION: Define concept to determine life remaining of non-airframe dynamic components (i.e. shaft, gears, and bearings) to improve maintenance scheduling. Concept should be defined by algorithms available, baseline data available, sensors and on-aircraft processing requirements, data management and displays of decisions. The product of Phase II will be the fabrication of the system, aircraft installation, and field tests.

A89-005 TITLE: Passive Personal Cooling Vest

DESCRIPTION: A passive personal cooling vest would maintain acceptable aircrew core temperatures while wearing ballistic and/or nuclear/biological/chemical (NBC) protective clothing. The cooling vest should perform both inside and outside the aircraft. The most desirable design would utilize passive cooling at all times, although active cooling while in the aircraft is acceptable. Passive cooling implies heat transfer away from the crew's core without an external energy source. An example of a passive cooling clothing is the robe worn by desert nomads. An example of active cooling is portable power pack and cooling system utilized by NASA astronauts between ground control and the launch system. Advantages of this passive system might include cost, weight, and simplicity. The major advantage would be capability of long-term escape and evasion in a contaminated, combat environment.

A89-006 TITLE: Simultaneously Radiated Multiple Frequency Susceptibility Testing of Aircraft

OBJECTIVE: Investigate the validity, of and the methods for, simultaneously radiated, multiple frequency susceptibility testing of aircraft and aircraft components as well as the risks incurred if the testing is not performed.

DESCRIPTION: Current susceptibility testing of Army aircraft and aircraft components involves the radiating of the unit under test with an electromagnetic signal that is at a discrete frequency while monitoring the system for susceptibility. This is done at a set of frequencies or while a frequency sweep is conducted over the required frequency range. With the increasing use of components and materials that exhibit nonlinear electromagnetic effects, the response of these components and materials to multiple signals that are at different frequencies are difficult to predict. Because of this, the validity of the standard approach of radiating the aircraft or components with only one signal is being questioned. The concern now is whether or not the aircraft and components should be tested using simultaneously radiated multiple signals at differing frequencies. Phase I of this project would be determined whether the traditional method of susceptibility testing is valid or if simultaneously radiated multiple frequency susceptibility testing should be performed. The analysis should include a description of the additional information

that would be obtained from this testing as well as the risks incurred by the Army by not performing this testing. Phase II would be to develop the methods for this testing. This would include development of pretest analysis methods, the actual test methods including a description of the types of equipment and facilities required, and post-test analysis methods.

A89-007 TITLE: Field Repairable Composite Airframe Structures

DESCRIPTION: Develop composite airframe structures field repairable design concepts that will minimize logistics requirements considering materials usage, repair equipment, training, and spare-parts inventory. The intent is to improve battle-damage repair capability in the field and demonstrate manageable field-repair concepts. Deficiencies in field-support/inspection equipment, material-processing capabilities and material-storage facilities will be highlighted. Phase I will include developing repairable-design concepts of various helicopter airframe structures such as skin panel (stiffened skin & sandwich construction), keel beams, and frames. Phase II will include fabricating in the field. Storage-capability solutions will be strongly emphasized.

A89-008 TITLE: Mach-Scale Remote Control Rotorcraft Technology

DESCRIPTION: Scale model radio-controlled rotorcraft represents existing technology. Such rotorcraft currently does not scale the rotor system so that the system stability can be matched to the operator response capability. Recent advances in control technology make it possible to design rotorcraft models at 1/5 scale with an aeroelastically- and aerodynamically-scaled rotor operating at the correct Mach number. The long-range objective is to develop a 1/5-scale model rotorcraft system that can accept model rotors from the wind tunnel for assessment of maneuvering capability and signature characteristics. The objective of Phase I is to provide a detailed preliminary design for the mechanics, power, and control of a 1/5-scale rotorcraft representing a four-bladed operational or conceptual helicopter in the Army fleet such as BLACK HAWK, Apache, or even the LHX. Designs shall be based on model rotor wind tunnel evaluations published by NASA and Army. The objective of Phase II is to manufacture such a scale model for wind tunnel performance and stability testing on a fixed sting. A complete free-flight evaluation is not envisioned.

A89-009 TITLE: Innovative Rotor High Lift Concepts for Helicopter Super Maneuverability

DESCRIPTION: An air-to-air combat scenario for helicopters has been recently introduced into the Army doctrine. The helicopter must therefore achieve an even higher measure of maneuverability and agility in the future. A major limitation affecting both high-speed flight and air-to-air combat is the loss of thrust due to rotor stall. This stall usually occurs on the retreating side of the rotor disc and at high blade angle attack. Conventional helicopters can pull no more than 2.5 g's during a maneuver, and this is equivalent to an average lift coefficient of 0.75 over the rotor disc. To achieve a 5-g turn would therefore require an average coefficient of 1.5, which is not an unrealistic number provided some type of auxiliary device can be used. While many concepts may appear to have merit, the task of actually implementing any active device on a rotor blade will be especially challenging to the designer. For example, centrifugal forces will have to be an important consideration for a mechanical standpoint. Furthermore, if the candidate device were to be slatted airfoil, the slat would have to be retractable to satisfy the low drag rise requirement on the advancing side during high-speed flight. Innovative ideas are therefore solicited for achieving a high life, stall-free rotor which will in turn enhance the maneuverability and agility of future Army helicopters. In Phase I, the contractor should examine various approaches and defined the advantages of a particular concept as it applies to the helicopter rotor. In Phase II, the contractor should construct and demonstrate a working model.

A89-010 TITLE: Smooth, Erosion Resistant Coatings for Organic Matrix Composites

OBJECTIVE: Erosion Resistant Coatings for Organic Matrix Composites for use in Compressor Section of Future Gas Turbine Engines.

DESCRIPTION: Work performed shall include development and verification of smooth, erosion resistant coatings on flat coupons of carbon-carbon or other organic matrix composites for potential application in inlet and compressor components of future gas turbine engines. Coating system shall be optimized and used to coat a sufficient number of coupons to verify good adherence to the substrate, smoothness of coating, sufficient retainment of mechanical properties of the base material, and sufficient hardness to withstand impact of sand particles experienced in gas turbine engines. Phase II work will entail further development and testing of coating systems that show promise from the results of Phase I.

A89-011 TITLE: Updating Current Electro-Magnetic Interference Electromagnetic Compatibility (EMI/EMC) Test Methods and Equipment

OBJECTIVE: Develop appropriate EMI/EMC test equipment used for qualification of Army aircraft and aircraft components.

DESCRIPTION: Test methods and equipment that are currently in use for the purpose of testing Army aircraft and aircraft components have been in existence for many years. Since these methods and equipment were developed, many advances have been made in the theories pertaining to electromagnetic compatibility/interference as well as in the related technology. Phase I of this project would be to analyze the test methods and equipment currently being used with respect to current applicable theory and technology to determine if these methods and equipment need to be changed. This would include the methods and equipment used for qualification of individual components and systems as well as for qualification of the entire aircraft. Phase II would be to develop new, cost-effective methods and to propose, develop or locate new equipment to perform this testing. This would include detailed test methods that include pretest and post-test analysis methods, lists of recommended equipment and the types of facilities where the testing should be performed.

A89-012 TITLE: Superplastic Forming and Diffusion Bonding of Cylindrical Casings

OBJECTIVE: Apply Superplastic Forming and Diffusion Bonding (SPF/DB) technology in the manufacture of static cylindrical components for gas turbine engines.

DESCRIPTION: The work to be performed shall include development of Superplastic Forming and Diffusion Bonding (SPF/DB) technology to apply to Army engine cylindrical static component designs such as compressor casings, combustor casings, or IPS housings. The Contractor shall propose the cylindrical component and engines that can best demonstrate the advantages of the SPF/DB process. A review of geometric, mechanical, and material design considerations shall be performed, and processing goals established for the chosen cylindrical component in order to apply SPF/DB technology in the most effective manner while maintaining or exceeding structural integrity. Phase II of the program will demonstrate and document viable manufacturing techniques including structural testing of the chosen engine component.

A89-013 TITLE: Interactive Exterior Helicopter Coating for Enhanced Ballistic Tolerance

DESCRIPTION: A basic approach to ballistic protection is to increase frontal area of the threat projectile. Increased frontal area is typically achieved by tipping and/or deformation. The objective of this effort would be an exterior coating (paint) that should adhere to the threat projectile. By depositing on the projectile the likelihood of tipping would increase along with increased frontal area. The anticipated improved ballistic protection level is relatively small. The proposed coating should be an integral portion of an overall aircraft pain scheme. The coating should be compatible with the other constituents in the paint and have no significant impact on overall weight added due to aircraft painting. The program objective would be a ballistically interactive coating whch could increase aircraft skin hardness by 5%, with no weight increase. Interaction would include coating deposition on the projectile and the corresponding increase in projectile frontal areas and tipping.

A89-014 TITLE: Model for Determining Effectiveness of Rockets with Multiple Kinetic Penetrators

OBJECTIVE: Develop models to describe terminal effects of multiple kinetic penetrators.

DESCRIPTION: The potential application of rockets with multiple kinetic penetrators (MKP) as a point fire air-to-air weapon generates a need for the development of realistic MKP rocket modeling and methodology capable of accurately determining the terminal effect MKP's in an aerial combat engagement. Current rocket models represent rocket time of flight and trajectory; however few if any have the flexibility or capability to accurately model the unique physical and statistical characteristic of an ejected cloud or clouds of kinetic energy penetrators as well as their terminal effects on selected aerial targets. In order to obtain a better understanding of this new kill mechanism, a concentrated effort to develop models and associated methodology capable of addressing this new weapons concept is warranted.

A89-015 TITLE: Unique Gas Turbine Combustor Aerodynamics

OBJECTIVE: Develop unique gas turbine combustor aerodynamics for future application to helicopters and build and test combustor visualization rig and/or fuel-insertion test rig.

DESCRIPTION: Unique concepts need to be explored for gas turbine combustor technology. Fuel mixing with the air in the combustor primary zone is a major problem, but has the potential for great benefits, which could result in smaller sizes, greater durability, wide range of multifuel capability, and lower fuel consumption. The feasibility of some innovative concepts could be determined by three-dimensional computer modeling and some very simple hardware such as a water visualization rig. The fuel-mixing problem could include unique fuel nozzle or any fuel insertion system. Wall-cooling techniques shall be considered as a trade-off between efficiency and size of combustor. Additionally, high velocity, but stable combustion should be considered to alleviate diffuser pressure loss. Phase II objectives are to build and test a combustor visualization rig and/or fuel-insertion test rig.

A89-016 TITLE: Automated Fiber-Reinforced Thermoplastic Fiber Placement

DESCRIPTION: Helicopter primary airframe structures must be lightweight, durable, and damage tolerant to meet requirements of future aircraft systems. Thermoplastic composite materials offer an order-of-magnitude improved toughness over their thermoset counterparts making thermoplastics very attractive for use in tailboom designs. These advanced materials in concert with design concepts to relieve the blast/overpressure caused by larger round ballistic impacts will give the helicopter increased ballistic tolerance for a minimum weight and cost. Hot Head Fiber/Tape Laying technology has matured to the point that a tailbone section can be fabricated and tested to demonstrate improved ballistic tolerance and moderate production rates to support future notional systems. Phase I will involve evaluating commercially available tows and tapes, material allowable development, and determining optimum hot head pressure/temperature parameters on a structural element level. Phase II will involve designing, fabricating, and ballistic testing of two or more tailboom section designs.

A89-017 TITLE: Rotor Performance Prediction Capability Using Advanced Aerodynamic Methods

DESCRIPTION: The current level of ability to predict helicopter rotor loads and performance is poor and new analysis (and their implementation in a comprehensive user-oriented code) are required. The specific areas that require improvement are the prediction of rotor wakes on advancing rotors and the prediction of the compressible aerodynamic response to the wake-induced inflow. Current wake-prediction methods use integral aerodynamic methods to predict the wake-induced inflow on a rotor and usually model (rather than actually predict) the wake. Current loads data indicate that these models are inaccurate. A requirement exists, therefore, for a wake-prediction method that does correlate with measured loading and preferably that does not rely on empirical wake information. All predictions methods (including integral and CFD methods) will be considered. This wake subsequently produces an azimuthally varying inflow environment in which a rotor must operate. The subsequent response of the rotor to this inflow is strongly Mach-number dependent. Therefore, a requirement also exists for an ability to predict the transonic, unsteady, three-dimensional local flow on the rotor. Methods for including viscous corrections to this

local flow are desirable. As especially important feature would be the integration of the various aerodynamic flow methods. That is, the wake and/or aerodynamic response methods should be integrated to a standard comprehensive rotor analysis code as well as to each other (if both are proposed).

A89-018 TITLE: Fire Retardant Coatings for Aramid Fibers

DESCRIPTION: As strength increases and density decreases, the application of the new high strength (aramid like) fibers in helicopters will increase markedly. Because of the state-of-the-art nature of the fiber application, some of the secondary materials considered are being ignored. That is, issues such as compressive modulus, fiber/adhesive wetting, fracture toughness, and lay-up are being optimized for primary and secondary aircraft application. This research program would include all aircraft fiber applications, but would have a primary objective application without resin systems. These “soft” fiber applications include cargo and personal webbing, netting, covers, bags, and curtains. Primary issues of the program will be coatings or treatment of fibers to: (1) improve flash point, (2) self-extinguished, and (3) minimization of hazardous gas generation. Since these fibers are not to be used in helicopters, the treatment must resist environmental deterioration or be easily renewable. It would also be desirable for the treatment to be usable for existing fibers.

A89-019 TITLE: Integrated Composite Flow Casting

OBJECTIVE: Develop near net shape fiber reinforced component fabrication by hot squeezed casting.

DESCRIPTION: This candidate program involves the evaluation of squeeze casting s an alternative to more traditional fabrication approaches for fabrication of fiber-reinforced airframe/engine components. Any candidate program should involve the feasibility evaluation as well fabrication and mechanical evaluation of generic test articles. Primary emphasis should be placed on fabrication of reinforced metal matrix composite components. Fabrication to near net shape or net shape desired. Phase II effort would involve fabrication of a full-scale component using the proposed process.

A89-020 TITLE: Direct Electric Tail Rotor Integrated Drive (DETRID) System for Helicopters

OBJECTIVE: Develop an innovative electric tail rotor application for helicopters in which a rotor blade acts as a core of an electric motor, providing the necessary anti-torque requirement.

DESCRIPTION: Phase I work performed will determine the feasibility and merits/penalties of integrating a helicopter tail rotor into an electric variable speed motor. The tail rotor will comprise the electric motor core. Rare-Earth (RE) magnets will be mounted on the blade tips. Around the rotor blade tips will be a circumferential ring of commutated field coils. Controls and switching logic/electronics will also be investigated. The total DETRID system should operate off that voltage found to be most efficient for the motor. Continuous max torque will be 120 ft/lbs. Blade tip max continuous rate of rotation will be 1,140 RPM. Reaction time for RPM speed changes will be 3-5 seconds. The tail rotor blades will be variable pitch. A variable pitch capability will be designed into the DETRID configuration. Tail rotor diameter will be four feet. Phase II would involve detailed design, fabrication, and bench-type testing for the DETRID configuration.

A89-021 TITLE: Airbag Crash-Protection Concepts for Single Cockpit Helicopters

OBJECTIVE: Develop a preliminary system design with limited testing of critical components.

DESCRIPTION: Cockpits for Army attack helicopters are becoming more confined as cross-section is reduced and more mission equipment is required adjacent to the pilot’s surroundings. This cramped cockpit of the future will, therefore, be replete with many head and limb strike hazards in the event of a severe but survivable crash impact. The feasibility of a self-deploying automotive-type airbag, filling the cockpit forward of the pilot, increases as cockpit volume decreases in future designs. The objective of this program is to determine the feasibility of such a

system considering the many design questions such as the number and location of airbags, crash sensor design, location and sensitivity, gas generator types and inflation times, system weight, and cost.

A89-022 TITLE: Crashworthy Crewseat Designs Having A 20-Degree Seat Back Angle

DESCRIPTION: Today's cockpits almost universally use pilot/copilot seats having affixed 13-degree seat back tangent line (reclined 13-degrees from vertical). Future cockpits are projected to require a more reclined pilot/copilot seating position due to reduced frontal area requirements and minimizing windshield area. The design implications and human tolerance considerations of crashworthy (stroking) seats having seat back angles at 20-degrees or more are unknown. Potential seat designs and how the seat designs and how the seat-occupant will function in a severe but survivable crash need to be explored. Potential hardware designs need to be defined along with their weight and cost implications.

LABCOM – ARMY RESEARCH OFFICE

A89-023 TITLE: Optimum Imagers For Image Processing

OBJECTIVE: To perform research on the interdependency between the image-detection process and image processing to optimize there combined performance for target acquisition.

DESCRIPTION: Much research is being performed to develop image-processing algorithms and the associated signal-processing hardware to provide reliable, real-time detection and recognition of objects. Most approaches, however, assume a standard rectangular array of image detector elements (pixels), either scanned or from a focal plane array. This process constitutes a sampling and quantization of the real-world analog image field. In this topic, research is sought to investigate the dependence of the performance of the image-processing algorithms on the image-detection process. The goal of the research is to identify the properties of the detection process that affect the accuracy and reliability of the image processing algorithms, to find the functional relationship between image detection and processing, and to use these relationships to define rules for optimization of the combined process. For example, hexagonal sampling of images has been shown to improve processing performance. The results of this research will be applicable to reducing false alarms and to improving the accuracy and reliability of target detection, classification, recognition, and identification. Original and innovative ideas for image detection and processing that significantly improve automatic target acquisition performance may result from this research.

LABCOM- ATMOSPHERIC SCIENCE LABORATORY

A89-024 TITLE: Ultraviolet Light Detection and Ranging (LIDAR) as a Remote Sensor

OBJECTIVE: Develop the capability for standoff detection of airborne toxins for Army aviation.

DESCRIPTION: An ultraviolet lidar system can provide information about the fluorescent signature (fluorescent spectrum and decay time) of a particular target material. This information can aid in identifying the material. The intervening atmosphere, background materials, and mixed compositions of targets make the actual return signal from an ultraviolet LIDAR a complex mixture of spectra. Decay time determinations from LIDAR data are further complicated because all fluorescent signals do not emanate from the same standpoint in space. There is a need for development of methods of recognizing the signature of target materials in the presence of competing signatures in a LIDAR return. Phase II efforts shall complete development of a demonstration operational UV LIDAR.

LABCOM- BALLISTIC RESEARCH LABORATORY

A89-025 TITLE: Interaction of Shaped-Charge Devices with Electromagnetic Fields

DESCRIPTION: The application of electromagnetic effects to shaped-charge design has the potential to provide new ways for modifying and enhancing device functioning, jet characteristics and the interaction of jets with conventional, special, and electromagnetic armor. Although the magnetic fields needed to produce significant effects are large, such fields are accessible for laboratory work. We are interested in proposals on high magnetic field confinement and entrainment in shaped charges during device functioning, and on shaped charged jet interaction effects with magnetic fields. Computer modeling of MHD effects is inherently more complex than hydrocode calculations for shaped-charged configurations As a consequence, such studies are expected to be expensive, time consuming, and of uncertain reliability. For this reason, we expect to emphasize experimental studies in our program.

LABCOM- ELECTRONIC TECHNOLOGY AND DEVICES LABORATORY

A89-026 TITLE: High-Temperature Superconductivity

OBJECTIVE: To identify the possible usees for, as well as the potential limitations of, high-temperature superconductors in high-impact Army technology areas.

DESCRIPTION: The basic microscopic theory of Bardeen, Cooper, and Schrieffer is used to estimate the characteristics of high-temperature superconductors- the critical distances over which the superconductivity occurs are quite small (20 angstroms), and the critical magnetic fields needed to destroy the superconductivity have extreme type-I values, with the lower critical fields of less than 1 kg and upper critical fields of 150 kg. The magnitude of the estimated characteristics has led us to identify the possible use as well as the potential limitations of high-temperature superconductors in high-impact Army technology areas. Formulations and speculations of artificially created semiconductor structures that might manifest high-temperature superconductivity are of particular interest.

LABCOM- HARRY DIAMOND LABORATORIES

A89-027 TITLE: Dual-Polarization 95-GHz Planar Antenna

DESCRIPTION: A compact 95-GHz antenna is required for development of a millimeter wave standoff fuze for self-contained munitions. Packaging constraints impose severe limitations on the design of both the millimeter wave hardware and the signal-processing elements that can be built in the fuze. Millimeter wave antennas for 95 GHz that are currently available require a considerable amount of space to achieve the type of operation that is required. A reduction in the antenna size would allow more space for other parts of the system and an overall in performance. A millimeter wave fuze design concept currently under investigation includes an antenna for circularly polarized radiation that has characteristics equivalent to that of a quality paraboloidal-type antenna. Compact antennas such as microstrip planar arrays and slotted waveguide arrays have been considered, but improvements in design or in fabrication techniques are needed in order for either of these types of antennas to meet other performance requirements. Proposals that identify methods for overcoming the known deficiencies of these types of antennas or for investigating new compact 95-GHz antenna designs are solicited. Phase I of SBIR program will consist of an investigation of a specific type of circularly polarized radiation. The antenna shall be able to receive simultaneously both senses of circularly polarized radiation, and it shall have an aperture of 15 cm or less in diameter and 3 cm or less in length. The investigation will include analysis and/or experiments that result in a preliminary design and an estimate of how well the proposed antenna will achieve performance goals of 41-dBi gain, 26-mrad 3-dB beamwidth, -18-dB sidelobes, 50 percent net efficiency, 30-dB cross polarization isolation, and 1-GHz bandwidth. Since ruggedness and fabrication cost will be of importance in an ultimate application, comments on these items also should be made in the proposal and at the conclusion of the first phase of the investigation. The second phase shall consist of the fabrication and test of a complete antenna that demonstrates the ability to meet the above performance goals.

LABCOM- HUMAN ENGINEERING LABORATORY

A89-028 TITLE: Effect of Speech Intelligibility on Performance: Testing in Operational Settings

DESCRIPTION: During the summer of 1987, the Acoustics Branch of the Human Engineering Laboratory began a research program to study the effect of speech intelligibility on solider performance. The first study was conducted at Fort Knox Coft tank gunnery training facility in February 1988. This research program is designed to produce measures of the effects of intelligibility on solider performance. The initial work is being conducted in simulators to provide the experimental control necessary to predict this intelligibility-performance relationship. Subsequent research would be conducted with operational units in the field. Various possibilities for extension of this research are available. One such possibility in the Infantry is described below:

Infantry Task. Infantry maneuvers can be broadly classified into three areas: attack, defense, and hostage. The following research is described for tow platoons of 11 soldiers opposing each other in a hostage situation. Similar research can be designed for attack and for defense maneuvers; here the hostage situation is used as an illustration.

Scenario: Whatever scenario is used must be communication- and strategy-intensive to allow us to measure the effects of degrading intelligibility. The hostage situation has three characteristics. The participants are only told the ground rules going in. They do not know the details of the rescue plan. These must be communicated as the progress of the rescue unfolds. A strategy-intensive plan is necessary disrupting communication of the overall success of the plan (the strategy).

Performance Measure. The measures of effectiveness are part-task and whole-task measures. Part-task measures are specific checkpoints in the scenario. (Terrorist appears. How long does it take to kill him?) Whole task measures are survivability and success of the mission. Performance measures are incorrect actions (killing a friendly), correct actions (killing a terrorist), correct strategy (hold fire until I give the signal), speed of response, rating of difficulty (SWAT), and debriefing evaluation of communication intelligibility.

Although some tasks may be more difficult due to visibility or motor-skill demands, within a scenario communication tasks should maintain a consistent level of intelligibility. Enough scenarios and variations on these must be created to allow for appraisal in repeated measures of design.

LABCOM- MATERIALS TECHNOLOGY LABORATORY

A89-029 TITLE: Joining of Composite Materials and the Nondestructive Evaluation/Characterization of the Resultant Joints

OBJECTIVE: Develop techniques to join advanced metal-matrix and organic-matrix composites materials and validated their structural integrity/reliability via nondestructive evaluation techniques.

DESCRIPTION: Develop innovative techniques to join advanced metal-matrix and organic-matrix (thermoplastic) composite materials. The joining methods could include the use of heterogeneous bonding agents such as adhesives and brazes, or autogeneous techniques such as fusion and solid material flow. It must be shown that any joining technique selected does not significantly degrade the properties of either of the composite materials being joined. Validate the structural integrity/reliability of these joining techniques via nondestructive evaluation/characterization methods to assess the interfacial, structural, and mechanical properties of the joints.

LABCOM- VULNERABILITY ASSESSMENT LABORATORY

A89-030 TITLE: Air Defense and Space Systems Electronic Warfare (EW) Vulnerability

DESCRIPTION: Technological advances to support the US Army EW vulnerability assessment (EWVA) program for air defense and space systems. The US Army EWVA program for air defense and space systems has been established to determine the performance of systems or system concepts in hostile EW environments and to develop

and recommend electronic counter-countermeasures (ECCM) to preserve system performance in these environments. Technological advances are needed in active and passive electronic countermeasures (ECM), ECCM, ground-based, and laboratory instrumentation and techniques, and analytical methods and techniques. These areas involve all regions of the electromagnetic (EM) spectrum. To advance ECM technology, as applied to air defense and space systems, there are requirements to address methods of active signal generation, cooperative CM's, and passive SM's such as chaff and obscurants. In the areas of ECCM, there are requirements to perform ground-based measurements of parameters of airborne CM's such as responsive ECM, cooperative CM, and cross section or density of passive SM techniques. There are significant shortfalls in the technology supporting analysis of air defense and space systems. Work needs to be done in the development of hardware and software models of terrain clutter, chaff or obscurants, and atmospheric clutter. Another area of importance and interest is the use of fractal geometry for simulation, graphics application, and image decoding and reconstruction.

TROSCOM- BELVOIR RDE CENTER

A89-031 TITLE: Development of Ultrasonic Inspection Method for Heavy-Section Organic Composites

DESCRIPTION: The bottom chord for the Heavy Assault Bridge (HAB) has been designed using graphite/glass/epoxy composite system. Each bridge uses 12 chords as critical structural support components. A chord is approximately 2.5 in. thick by 30 feet long, with thickness ranging from 1.25 to 3.25 in. The chords are produced by hand layup techniques, and have as many as 600 layers of fibers in a cross section. The ration of 0 degree graphite/ 90 degree graphite/ 45 degree pre-impregnated glass cloth layers varies along the length of the chord in order to take advantage of preferential reinforcement properties. The design of the chord also includes bolt holes, lined with steel brushing, through the thickness at various points along the chord length.

Since chords are considered critical components of the HAB, a nondestructive testing method is needed to inspect the chords for discontinuities that may be detrimental to their in-service use. Preliminary investigations indicate that some form of ultrasonic inspection would be appropriate for this heavy sectioned composite. This program will concentrate on developing an ultrasonic technique that will be capable of inspecting a full-size chord for discontinuities, and potentially to differentiate between types of fibers (graphite, glass). The equipment and procedures should be applicable to the environments of both production (quality control) and depot (damage assessment).

Phase I will choose the ultrasonic method to be used and prove, through testing, that the method is applicable to the chord involved. In Phase II, the procedure will be refined, and the sensitivity of the method will be determined for specific discontinuities at the applicable thicknesses for the chord. The procedure developed would then be used in quality control of chords to be procured in future contracts.

TROSCOM- NATICK RD&E CENTER

A89-032 TITLE: Improved Polymers for Adhesives for Bonding Selected Elastomers

DESCRIPTION: Butyl rubber is resistant to traditional chemical and mechanical bonding. Some types of adhesives such as selected neoprenes provide a degree of bonding butyl, but improvements are desired. Numerous butyl rubber articles and butyl coated fabric items are in use and many of these must be cemented together either in production or during repair or damage. It is desirable for greater durability to obtain adhesion stronger than the rubber itself or stronger than the bond between the rubber coating and fabric substrate.

Hypalon (chlorosulfonated polyethylene) polymer is difficult to bond to itself and to other materials. In specific applications, we are dealing with Hypalon coated fabrics to which other materials must be bonded to fabricate an item. For example, one side of the fabric may be coated with Hypalon and the other with another polymer. The Hypalon must be bondable both to itself and to the other polymer in this case.

Similarly, it is sometimes required to bond butyl rubber to polar rubbers such as polyepichlorohydrin, a satisfactory adhesive for this purpose has yet to be found.

Many adhesives have been made and tried using commercially available polymers but none have proven entirely satisfactory. It is desired to develop new polymers for the above applications. Adhesives made from these can be either solvent based or two-part curable adhesives or for some applications heat-activated adhesives.

MISSLE COMMAND

A89-033 TITLE: Improvement of Test Instrumentation for Filament-Wound Structures

DESCRIPTION: Filament-wound composite structures are more difficult to instrument than typical autoclave-cured structures due to the inherent rough exterior surface and the irregular surface at the fiber crossovers. Many tests are redone to poor adherence to the rough surfaces and false readings from the crossovers. There is a need for research to improve the test instrumentation of filament-wound structures.

A89-034 TITLE: Antenna Cross-Coupling in a Damped Resonant Cavity

OBJECTIVE: Derive antenna configurations and associated design parameters that meet specific requirements.

DESCRIPTION: The need exists to investigate the antenna configuration for an RF anechoic chamber that can simulate a controllable, free space RF environment at VHF frequencies and in which the internal dimensions of the chamber are limited in width and height to between one and two wavelengths. Specific requirements are:

a. Dual horizontal and vertical polarization.

b. Capable of presenting a plane wavefront with controllable orientation angle in three dimensions at a particular receiver location in the chamber.

c. Minimum mutual cross-coupling such that phase and amplitude of the input signals to each antenna to yield the desired plan wavefront angle and signal level at the receiver location can be readily generated under digital computer control over as wide a range of wavefront orientation angles and signal levels as possible.

A89-035 TITLE: Automatic Target Model Degradation

OBJECTIVE: Support the automatic creation of less detailed but accurate target models for hardware-in-the-loop flight simulations.

DESCRIPTION: Innovative techniques are needed to degrade the resolution of an infrared target model description to any level of detail. These techniques must consider the computational time necessary to degrade the image. This procedure must be able to be implemented on a large-scale engineering workstation. More specifically techniques are needed to (1) take a high resolution, three-dimensional, faceted-target model geometry and automatically degrade it to a less-detailed, lower-resolution target model, and (2) take a high-resolution, three-dimensional, faceted, infrared target representation and automatically degrade it to a less-detailed, lower-resolution, infrared representation while maintaining the fidelity of the signature. The techniques developed must be capable of running on UNIX-based engineering workstations such as an IRIS 4D60 Turbo, and must require minimal human intervention in their operation and the creation of output files to be used by other computer programs.

A89-036 TITLE: Data Enhancement Techniques for Measurements Using Bandwidth-Limited Instrumentation

DESCRIPTION: The-state-of-the-art measurement of fast non-repetitive transients (such as MIL-STD-2169) is usually less than that required for a concise, accurate measurement. Some compromising of the bandwidth of the

sensed signal is usually required in order to provide for pre-trigger delay, signal transmission over a long transmission line, etc. The introduction of noise into this situation makes the design of a restoration technique especially difficult. The development of a data-enhancement system for restoration of the bandwidth of signals that is tolerant to noise is required. The system shall be capable of restoring a signal that has been bandwidth degraded by as much as 2:1 in a signal-to-noise environment of 16dB. This data-enhancement system shall require little or no operator interaction and shall provide an assessment of the quality of the reduced data. This system shall be capable of being operated in the environment of an advanced personal computer.

A89-037 TITLE: Solid State Electronic Gimbal

DESCRIPTION: Methods are needed to dynamically reduce the size (underscan) and control the position of the underscanned area on the photoconductive surface for solid-state imaging devices such as charged-coupled devices (CCD's) and charge-injection devices (CID's). Variable underscanned areas of up to 4:1 are the goal. For a typical solid-state device with a 400 x 400 pixel array format. Underscanning the photoconductive surface by a factor of 4:1 implies utilization of one-fourth of the total sensor area available; one-fourth of the total array implies that 100 x 100 array. Dynamic control of the position (location) of underscanned array implies that the 100 x 100 pixel portion can be located anywhere in the entire 400 x 400 array. Therefore, at any particular time, only one-fourth of the photoconductive surface is being used. Standard video output format must be maintained regardless of underscanning ratios and position of the scanned area. Linear resolution degradation, with respect to degree of underscanning, is recognized. Dynamic positioning control (or new position update) and size control shall be from DC to the TV frame rate. The technique of moving the reduced scanning area over the sensor surface is analogous to the angular motion imparted to a TV sensor mounted on an electro-mechanical gimbal and will be referred to as solid-state electronic gimballing. One practical application is to provide image stabilization electronically rather than with electro-mechanical gimbals.

A89-038 TITLE: Concepts for Spatially Encoding Millimeter Wave Beam

DESCRIPTION: Innovative concepts are needed for spatially encoding millimeter wave beams for beamrider missile guidance applications. A rearward-looking receiver on the missile senses its position in the beam from the spatial coding, and provides corrective commands to the missile to cause it to fly down the center of the beam. The concept should be lightweight, small in size, and cause it to fly down the center of the beam. The concept should be lightweight, small in size, and economical to produce. The construction of a prototype beam projector and receiver and validation of the combined performance is an essential part of the Phase I effort. Millimeter beamrider guidance has potential for direct fire, armor applications, and as the mid-course phase of a concept that features handover to a homing seeker for the terminal phase. The concept developed under this program should be applicable to both guidance concepts. The long-range objective of this program would be a brassboard demonstration of the beam-encoding concept that includes the receiver.

A89-039 TITLE: Ceramic Components for Turbojets

DESCRIPTION: The performance of small gas turbine engines can be significantly improved by utilizing a ceramic turbine and bearing because of the higher operating temperature such components would allow. Ceramic turbines have already been introduced in turbochargers and it would be extremely worthwhile to exploit this available component in a small tactical turbojet. Innovative research is required to integrate a ceramic turbine and bearing into a tactical turbojet engine. Feasibility investigations must include determining the operating temperature limit and operating life of such components in the context of a small, short duration tactical turbojet engine.

A89-040 TITLE: Correlation of Insensitive Munitions Tests to Card Gap Values

DESCRIPTION: Research is needed to establish the correlation between card gap values and sensitive munitions tests for various missile propellant formulations. Results from shock sensitivity and bullet impact testing will be compared with the corresponding card gap values for the propellant formulation question. Comparison of such data

provided to the investigator will then be used to determine the relationship of shock and bullet impact sensitivity to corresponding card gap values. This correlation could then be used to predict the response to such sensitive-munitions testing of a propellant formulation based on it's known card gap value.

A89-041 TITLE: Tandem Warhead Technology

OBJECTIVE: Establish a theory of tandem warhead behavior by establishing design algorithms and testing procedures.

DESCRIPTION: Tactical missiles attacking hard targets, i.e., tanks, bunkers, etc., will rely increasingly on tandem warhead technology. The effectiveness of two or more warheads to defeat advanced armor has been proven in several programs. Valuable information about physics of warhead interaction and its effect on performance has been acquired. The investigative programs have been expensive, and have frequently had detrimental impact on overall program schedules. Critical parameters affecting tandem warhead performance are required so that design and testing can be accomplished more expeditiously. Of special importance is a means of predicting blast-induced interactions and their effects on jet formation and performance. Means of minimizing the detrimental interactions are needed. The effects of separation, jet speed, and time delay on performance should be characterized.

A89-042 TITLE: Non-Destructive Evaluation (NDE) Methods/Technologies Applicable for Nozzles Made of Reinforced Phenolic

DESCRIPTION: There exists a need to determine and prove NDE/Methods/Techniques that analyze reinforced phenolic materials currently being used for nozzles of various systems. This technology is very much needed to determine missile/rock and detect cracks, porosity, voids, and other anomalies in the nozzles that influence the mechanical properties and therefore, could cause strength variations that may result in nozzle failure. These methods are also needed to determine reasons for poor repeatability of mechanical property data that have been experienced by these materials. This effort would verify and simplify the utility of this most promising non-destructive test methods of phenolics in nozzle applications.

A89-043 TITLE: Development of Physically Low Thickness Radio Frequency-Absorbing Material

DESCRIPTION: A material for lining the boundaries of an RF anechoic chamber that stimulates a free-space environment at VHF/UHF frequencies is required to be designed and developed. The material is required to have a physically small thickness relative to the wavelength of the lowest RF frequency used in the chamber.

A89-044 TITLE: Dynamic Stability of Flexible Missiles

DESCRIPTION: Slender spinning missiles are suspected to be sensitive to dynamic coupling between the spin and the transverse axes. This phenomenon could be triggered by strain energy stored within the missile body due to launch conditions and/or structural damping. Spinning satellites with nutation dampers have been studied in detail. The same phenomenon will probably exists for slender flexible spinning missiles flying within the atmosphere. Aerodynamics will affect their behavior until burnout. Innovative research is needed to determine the magnitude and possible effect of this coupling on the behavior of missile trajectories. Sudden momentary transfer of rotational energy from spin about the minimum axis of inertia to some other configuration could explain some observed flight abnormalities. The follow-on phase involves improving the range and accuracy of rockets and missiles. The goal would be to accurately launch and fly to line-of-sight targets at hypervelocities to extended ranges. Missiles with high length-to-diameters will be required for low drag.

A89-045 TITLE: Large Size Indium Gallium Arsenide (InGaAs) Protodetectors

DESCRIPTION: Indium Gallium Arsenide (InGaAs) Protodetectors are becoming quite important in receivers for fiber optics communications systems and eyesafe laser rangefinders in the 1.3 to 2.1 micrometer spectral region. At present, the detectors are small (1-2 mm diameter or less), and cannot be used in laser seekers or trackers which have a large field-of-view and thus require large detectors (greater than 1 cm diameter). Quandrant detector configurations are needed for many of the applications. Research is required to develop the large-area detectors that must have high sensitivity to pulsed laser radiation.

TANK AUTOMOTIVE COMMAND

A89-046 TITLE: Large-Area Passive Broadband Laser Filters

OBJECTIVE: Successful fabrication and demonstration of a broadband filter can be integrated and used with existing unity vision equipment designs.

DESCRIPTION: A need exists for broadband laser filters that operate in the visible region (400-700 nanometers), do not require any external biasing (thermal or electrical) or a focal plane, and can be used over relatively large areas (100 square cm). The filter should normally have a high photopic transmission (50% or greater) and must provide protection against both pulsed and continuous wave (CW) lasers. It is recognized that a combination of approaches may be necessary to meet these goals.

TECOM- WHITE SANDS MISSILE RANGE

A89-047 TITLE: Multispectral Data Processing

DESCRIPTION: Multisensor tracking platforms for instrumentation support of inflight missile and aircraft systems testing are being developed that will have a high-resolution coherent millimeter wave (MMW) radar collocated with visible and infrared imaging sensors. Development of a processing methodology is required that is capable of cooperatively integrating the information available from all three sensors to provide a comprehensive estimate of flight vehicle position, attitude, and event parameters. For example, the attitude information available from visible and infrared sensors might be augmented by the spectral information available in the radar return. (The processing technique that provides the detailed spectral analysis of coherent radar signals has already been developed and is used on a regular basis).

Conversely, the visible and infrared images might better define the range data available from the radar return. Hardware requirements and architectures commensurate with the proposed methodology and expected processing loads need to be identified.

A89-048 TITLE: Digital Focusing

DESCRIPTION: The focusing of optical instruments during optical track is currently done using radar data. Accuracy needed for many missions requires a more precise focusing method. Focusing based upon analysis of real-time video images using special purpose hardware will result in more accurate focus. This hardware could work either in the frequency or time domain. Focusing algorithms must operate at rates high enough to keep video cameras focused while operating at sixty fields per second. Commercially available systolic array architectures, such as the GAAP chip produced by NCR Corporation, appear to be promising as low-cost hardware engines for solving the focusing problems encountered in tracking high-dynamic targets. The desired objective is to produce a low-cost hardware design that can solve this focusing problem.

TECOM- COMBAT SYSTEMS TEST ACTIVITY

A89-049 TITLE: Heat Flux Sensor for Vulnerability Testing

DESCRIPTION: The US Army performs vulnerability tests on many of its weapon systems. Testing usually involves exposing a fully loaded weapon system to live anti-armor ammunition. The weapon systems under test are loaded with ammunition, fuel, dummies in place of troops, and various instrumentation. During vulnerability testing the dummies inside the test item can be exposed to adverse temperature and heat flux conditions. Temperatures can exceed 2000 degrees Fahrenheit. It is important to measure the conditions each dummy member has been exposed to during a live-fire event. Of particular interest is the heat flux levels necessary to cause second or third degree burns to the human body. An appropriate model for heat flux versus burn to the human body will be selected. A sensor will be developed that can accurately measure the heat flux levels necessary to cause burns to the human body. Calibration equipment will be developed that will allow the user to verify the operation and accuracy of the transducer just prior to testing. The transducer will be small enough to be mounted at one of several locations on a dummy placed inside the weapon system under test. The transducer output will drive at least 200 feet of shielded low impedance cable.

TECOM- YUMA PROVING GROUND

A89-050 TITLE: In-Bore Motion Detection System for Flash X-Ray Trigger

DESCRIPTION: The present, non-contact method for triggering is mounting in the gun barrel pressure transducers that detect the passage of the projectile. This method is not acceptable for thin-wall gun barrels, composite gun barrels, and for in-bore flash X-ray studies. This and the alternative method of using strain gages often do not work when an in-bore malfunction disturbs the normal pressure characteristics. A new non-contact method for triggering is required to meet these applications. The primary application would be for main tank guns but should also be suitable for artillery weapons.

TECOM- ELECTRONIC PROVING GROUND

A89-051 TITLE: Testing Embedded Parallel Processing-Based Systems

OBJECTIVE: Creation of a set prototype software tools for testing embedded systems employing parallel processing technology.

DESCRIPTION: A variety of Government and industry-funded research initiatives are underway to create, develop, and transfer to production computational environments based on multiple processors operating in parallel to generate levels of computing power beyond what is available in conventional architectures. A number of these environments have already reached the stage of commercial products. The computational models upon which these environments are based differ in terms of granularity of parallelism, degree and methods of coupling processing between processing elements, topologies, and protocols for interprocessor communication. Testing of embedded systems employing these environments is likely to require novel techniques, and these techniques will vary to some degree with the computational model implemented. Moreover, the implementation of the model employed as the technology will be, for some years to come, immature in comparison with compiler, operating system, and architectural technology of current systems. This task should seek to establish a working taxonomy of computational models, build an extensible tool to aid in identifying and characterizing systems under development in terms of the taxonomy and build a prototype tool to generate, from a library of proven algorithms benchmarks for testing model features implemented in the environment to be tested.

TECOM- DUGWAY PROVING GROUND

A89-052 TITLE: Optical Sensing Using a Naturally Illuminated Scene

DESCRIPTION: Current scintillometers utilize a transmitter and receiver to define an optical path; however, crosswinds can be measured using a naturally illuminated scene (i.e., no transmitter). Path-weighting functions can become complex, but the procedure is feasible. A scintillometer of this design has significant military applications for correcting gun azimuth and elevation for optical distortion and crosswind. The objective is the development of a scintillometer that will utilize the naturally illuminated scene.

CECOM- CENTER FOR COMMAND, CONTROL, AND COMMUNICATION

A89-053 TITLE: Artificial Intelligence for Command and Control

OBJECTIVE: The objective of this effort is to design a tactical decision aid for eventual use by an Army commander or staff member.

DESCRIPTION: The decision aid should be designed to significantly enhance military planning as currently practiced in the field or in garrison. The target environment for the decision aid is a testbed that supports extensive Army user interaction within field training or command post exercise. The design must integrate artificial intelligence techniques with other technologies into a system of demonstrable utility to an Army user.

Possible decision aid include (but not limited to)-

1. A wargaming facility that provides detailed explanations to user questions;
2. A course of action advisor/critic;
3. An integrated geographic information system and terrain analysis system;
4. A site-selection advisor (e.g. signal centers, supply points, headquarters location);
5. A force-movement analyzer that advises staff member on movement alternatives and time constraints;
6. A terrain-management tool which assigns both combat and support units to appropriate locations;
7. An obstacle-emplacement advisor for preparing a combat engineer barrier plan;
8. A route-selection/evaluator system for logistics support;
9. A tool that projects fuel consumption rates based on terrain, weather, vehicle types, mission, etc.;
10. A system that intelligently displays and manages tactical graphics for staff planners;
11. A distributed force-level control system that facilitiates cooperative problem solving among dispersed command posts.

The decision aid must be effective, yet easy to use. As an example, consider the portrayal of battlefield geometry, which many of the above systems must represent. It consists of –

1. Control measures (e.g. flight corridors, objectives, axes of advance, phase lines, prepared positions, main supply routes, lines of communications, bridging sites, and avenues of approach);
2. Key terrain;
3. Barriers and obstacles; and the
4. Communications grid (including indigenous capabilities and electronic warfare network coverage).

A useful decision aid must allow rapid and easy input of battlefield geometry by the user. The system should provide explanations as necessary; but unobtrusively support the user's mission.

A successful system design will-

1. Describe the user's environment;
2. Identify the specific user needs to be addressed by the system;
3. Specify the functional components of the system and their interrelationship; and
4. Describe the procedural basis of each component to an appropriate level of abstraction.

The first three items listed above should be written in a manner accessible to regular Army personnel for their review and comment. A limited prototype demonstration of the objective system is desirable, but not mandatory.

CECOM- CENTER FOR SOFTWARE ENGINEERING

A89-054 TITLE: Requirements Engineering Technology

DESCRIPTION: The requirements statement for an Army system can be viewed as an architectured product, with an associated life cycle. This leads to the notion of requirements engineering that can be defined as "a systematic approach to the development, transition, evolution and dissolution of requirements for a system." This is a relatively new concept with little or no supporting technology. The purpose of this SBIR topic is to solicit innovative ideas and promising techniques that would be a foundation for, or be an integral part of, requirements engineering.

Phase one products would be reports establishing proof of concept or describing the approach and procedures to be used for the requirements engineering techniques proposed. Phase two products would involve demonstration of techniques, prototype tools, and reports fully describing the techniques and procedures developed and recommendations for incorporating those techniques and procedures into the system life cycle.

CECOM- CENTER FOR EW/RSTA

A89-055 TITLE: N-Feature Electronic Support Measure (ESM) Data Clustering and Matching

DESCRIPTION: Rapid clustering and matching of N-feature sensor data in a high density EW environment is critical to ESM/ECM performance. The availability of multisensor data with intermingled feature parameters offer a good application for clustering and matching algorithms and techniques. High-density signal environments are composed of large numbers of signals in time/spectral overlap, not easily separated by the window addressable memory functions currently utilized. The EW objective in this case if to conduct N-feature space clustering and matching for rapid signal separation, identification, and decisions. The solution should address threat system War Reserve Modes (WARM) and agilities, adapt to changing signals and environments, and have the capability of developing and extracting operational templates for optimum tracking and/or prediction in the support of countermeasures or hand-off to hard kill tracking weapons. In these applications it is necessary to reliably isolate a single emitter or system in a complex feature space having closely related neighboring signals and adapt to changing signals and environments.

The Phase I effort will evaluate and analyze innovative processing approaches, techniques, designs, or algorithms which achieve signal separation goals. The concept shall be defined and assessed in comparison to existing methods and systems. The goal of Phase I shall be to define the problem and to demonstrate analytically concept feasibility. The Phase II effort will concentrate on detailed definition of the concept with a demonstration, test, and verification of proof-of-principle.

CECOM- CENTER FOR SIGNALS WARFARE

A89-056 TITLE: Antenna- Amplifier Network Integration

DESCRIPTION: The objective is to develop a modular power antenna-amplifier using field effect transistor (FET) technology to achieve a non-linear active antenna impedance matching network with very high power density non-linear amplifier. The antenna-amplifier is to be the linear transmitter for small jammer, e.g., RPV, expendables, as well as the basis for forming very high power transmitter from a few modules. It must provide good efficiency for maximum emitted power output. It is desired that distortion products be as low as possible to provide low harmonic content in large transmitters, but must be held to a practical value in order to maintain reasonable efficiency. This work is aimed at simultaneous dramatic improvements in antenna-amplifier power and bandwidth for a given size, which will require a substantial improvement over present capability. Highly imaginative and innovative techniques will probably be required, but must be limited to practical approaches usable for military applications such that

further development could produce equipment suitable for operation and maintenance by US Army forces in the field.

In jamming systems, requirements for large gains, bandwidths, directivity, and efficiency are often present. When the weight and size of the installation are not of overriding concern, the preferred approach would be to use antennas of sufficient size to ensure that these objectives are met. Such antennas are usually several wavelengths or larger in size, and then typically include conventional dipholes, whips, log periodics, and other types. In many cases, however, such as with small mobile platforms (e.g., jeeps and small RVPS), the available space may be extremely limited. In addition, other limits are sometimes encountered, such as the often critical aerodynamic constraints associated with some RPVS, which do not allow the use of large antennas. “Electrically small” antennas or antennas that exhibit maximum dimensions less than a half wavelength, are often the only alternative. Unfortunately, electrically small antennas have imposed severe limitations upon the overall efficiencies of these jamming systems, particularly where broadband operation is desired.

PHASE I- The feasibility of an antenna integrated with active amplifier circuitry is to be investigated to achieve significantly improved performance. This would be accomplished via design analysis of active circuitry driving the very small radiation resistance directly without the necessity of matching impedances to a common level (normally 50 ohms). The major thrust of this effort is to develop unique approaches to the design of broadband, electrically small antennas, with improved transmitting efficiencies, through the use of active circuitry. That is active circuits are to be used in place of conventional, passive matching networks for improved bandwidth and matching efficiency. In addition to this, the actual antenna structure is to be integrated (attached directly) with the RF amplifier itself so that the two are considered as one entity (with possibilities for improved performance).

PHASE II- The contractor shall design, fabricate, test, and evaluate an interim antenna amplifier of each possible candidate type to demonstrate the achievement of 3- to 300- MHz and 1-30-MHz bandwidths using existing low power FETs. The minimum power output should be 100 watts. This design should also demonstrate achieving high radiated efficiency and distortion and spurious products output requirements.

Using the output of above, the contractor shall design, fabricated, test, and evaluated a high power design of each type using any available and/or experimental high power transistors, or combination of circuit approaches if only low power devices are available. The minimum RF power output in the fundamental frequency should be 250 watts continuous wave (CW) from 3 to 300 MHz and 500 watts, 1 t0 30 MHz. The design should show achieving the frequency range and any tuning time, efficiency, distortion, and spurious products and be at the smallest possible physical dimensions achievable, limited only by the thermal hotspot temperatures of the components for CW operation. Each candidate shall be evaluated for attainment of all of the performance, physical, and other requirements. The emphasis shall be on achieving high power density (watts per cubic cm, watts per kg). The amplifier shall demonstrate the feasibility of being air cooled (with the use of fans) when in a stand-alone or two – amplifier configuration for small jammers and being liquid cooled when in multiple BPM amplifier configuration for large standoff jammers.

CECOM- CENTER FOR NIGHT VISION AND ELECTRO-OPTICS

A89-057 TITLE: High-Temperature Superconducting Infrared Sensor Components

DESCRIPTION: The following class of projects involves applying the results of new high-temperature superconductors to infrared systems:

1. Bolometric Sensor- This involves using the superconducting transition temperature as the infrared sensor mechanism.

2. Weak Link Detector- This involves using the weak link properties of the superconductor as an infrared detector.

3. Thermoelectric Cooler- This involves the use of superconducting elements in the cold stage of the TE cooler to achieve lower temperature.

4. Superconducting Optical Shutter- This involves using superconducting as an optical switch.

COE- CONSTRUCTION ENGINEERING RESEARCH LABORTORY

A89-058 TITLE: Cognitive Formatting of Electronic Documents

DESCRIPTION: In the future it will be possible to get both an electronic copy and a papery copy of almost any document. To alleviate the classical "precision vs. recall" problem of information retrieval, it would be helpful to embed in the electronic document electronic "flags" that classify the document as to its "cognitive form". Several standards for word processing and for publishing are available, but currently no standards exist for classifying the cognitive aspects of a document's contents. A classification system needs to be developed that classifies the knowledge contained in a document by several "orthogonal" references axes. (One would hope that an orthogonal retrieval approach would increase "recall" without reducing the "precision" of an information retrieval search). The document content classification system should be generic enough to be used in both the Arts and the Sciences, and should allow for sub-sets of more restrictive classifications peculiar to certain discipline.

A89-059 TITLE: Video Imaging for Building Interior Maintenance Inspections

DESCRIPTION: Facility maintenance inspections are performed periodically for determining facility condition and work needs. Visual inspection procedures are almost exclusively employed. This is a very labor-intensive process and limits the amount of actual inspection that can be performed due to resource techniques be developed that can capture the needed inspection information for building interiors. The information should be captured, digitized, and be transferred directly into a computerized database.

A89-060 TITLE: Underground Storage Tank Finder

DESCRIPTION: Leaking underground storage tanks (UST) are a major source of groundwater pollution in the United States. There are over a million known UST's and many more unreported abandoned UST's whose exact location is not known. The purpose of this project is to develop a field-portable device to locate abandoned and unreported UST's that are constructed of steel, fiberglass-reinforced plastic, concrete, and other construction materials. The UST locator should strive for low cost as well as simplicity so that it can be used by field personnel.

A89-061 TITLE: Lead Concentration Monitoring and Compliance in Drinking Water Distribution Systems

DESCRIPTION: Recent amendments to the Safe Drinking Water Act (SDWA), applicable to all Army installations, require extensive monitoring for lead concentrations in drinking water at the consumer's tap. If the lead concentration exceeds maximum containment level (MCL), the SDWA requires modifications in the treatment process to reduce the lead contamination level. The objective of this research is to develop a non-intrusive standardized test method for lead control, which does not require utility personnel to enter consumer's homes. The standard test will be designed to optimize treatment technique requirement for Army water utilities to implement, aimed at the minimization of lead leaching from home plumbing, in particular.

COE- ENGINEERING TOPOGRAPHIC LABORATORY

A89-062 TITLE: Controlled Digital Image Data Base

DESCRIPTION: Develop the concept of a controlled multisensor digital image database where the digital image database is to be regarded as a component of a larger database that includes knowledge bases, factual databases, and a dynamic target database. The dynamic target database pertains to current locations of targets detected in the past as well as predictions of their future locations. The conceptual development must include a discussion on means to

rigorously adjust a variety of digital images (EO, SAR, and IR) to a common coordinate frame. The discussion will include existing work on multisensor record registration as well as a discussion on known software means to store images and to access sub-images with respect to the proposed image database theory. Two primary uses of the digital image database will be to provide a background for database viewing and to provide a controlled database for registering remotely collected digital images for the purpose of target location and analysis. These functions must be discussed in the development as well as other functions. For example, since the image set is controlled it will be possible to produce information on a suspected target from several spectral viewpoints. Comparisons will be made with factual databases (terrain databases and digital map data) with respect to the functions. For example, when weather data and environmental conditions are fused with terrain data to provide statements about the surface condition of the battlefield how can the generated database best be viewed by the user.

A89-063 TITLE: Development of Digital Terrain Feature Models for Automated Feature Extraction

DESCRIPTION: Object recognition and identification in industrial computer vision deal with relatively simple and predictable objects that lend themselves easily to image modeling. Image models may be represented symbolically and used in the recognition and identification process. Examples are automated part inspections or industrial robot controls. The pixel structures of terrain features on digital imagery are not simple and how a large degree of variation. Image modeling of a digital terrain feature requires in depth analysis of a sufficient large number of samples for each particular terrain feature. The development of digital terrain feature models must include but not be limited to – quantitative measurements of the digitized spatial gray-tone distribution of the feature; definition, identification and measurement of image feature primitives and descriptors; determination of feature-to-background characteristics; investigation of the effects of the geographic location on the feature characteristic; evaluation and utilization of image interpretation rules and logic; identification of image processing algorithms and computer vision techniques; approach and strategy required for effective and efficient automated feature extraction. The feasibility of digital terrain feature model development shall be demonstrated using the following feature classes- roads, intersections, and forests. Digitized samples from aerial photography of these two feature classes may be made available on request for the Phase I effort. More feature classes may be added for Phase II.

COE- WATERWAYS EXPERIMENT STATION

A89-064 TITLE: Passive Airblast Attenuation Valves for Conventional Weapons

DESCRIPTION: Design several types of passive airblast valves to replace active blast valves currently being used. Recent data from full-scale tests using general-purpose bombs indicate that active valves are not more efficient at reducing blast pressure than an equal airflow constriction that does not close. The potential savings using low-cost, low-maintenance, passive valves are considerable. The passive valves should be about 2 feet square by about 2 feet deep to fit into the existing configurations. They should reduce peak pressure about two orders of magnitude, i.e., from 500- to 1,000-psi input peak pressure to about 5- to 10-psi output peak pressure. Note that 400 psi to about 15 psi. the passive valve designs should not cause more resistance to normal airflow than existing active valves. Selected designs will be constructed and subjected to actual thrust airblast environments.

COE- COLD REGION EXPERIMENT STATION

A89-065 TITLE: Equipment for Measuring the Mass Concentration of Solid Particles Suspended in Air

DESCRIPTION: Equipment is required to measure and record the mass concentration of solid particles in air. When the air is moving (as in windy weather or in a wind tunnel), the equipment must also measure and record the mass flow rate (i.e., concentration times velocity). This equipment must be suitable for measuring profiles across a turbulent boundary layer as for instance the concentration and flux of blowing snow from ground level to a height of about 4 meters, with winds up to 30 meters per second (60 knots). Mass concentration of solids is expected to be in the range from about 0.1 to 500 grams per cubic meter. Mass flux of solids is expected to range from about 0.7 to 8,000 grams per second. Mean particle size is approximately 0.1 millimeter.

A desirable but not essential second application for this equipment is expected to be a requirement for measurements in a wind tunnel that blows a suspension of very small activated clay particles (with the finest fraction behaving almost like smoke). In general from this equipment would be suitable for measurements of any dust or powder suspensions in air or other gas.

Proposals must include a description of the calibration and validation methods to be used to verify the proper performance of the equipment.

ARMY RESEARCH INSTITUTE FOR BEHAVIORAL AND SOCIAL SCIENCES

A89-066 TITLE: Advanced Technology Applications for Foreign-Language Training and Sustainment

DESCRIPTION: Changes in military doctrine on operational readiness in response to world conditions have resulted in an increased demand for military personnel qualified to communicate in a foreign language. In order to train and maintain a level of proficiency in foreign-language skills adequate to meet this demand, the Army is seeking to capitalize on the strengths of technology, particularly Artificial Intelligence, for producing language-learning and sustainment environments. Effective systems need to be developed to create intelligent, interactive learning within English and critical foreign languages such as German, Korean, Russian, and Spanish. Effective architectures need to be investigated and synthesized in these environments, using hypertext, multimedia, natural language processing, and large-scale databases and dictionaries. In addition, the technologies of intelligent tutoring need to be exploited to provide adaptive delivery environments using student modeling, error diagnosis, and effective knowledge-representation techniques. An effective environment in English and one foreign language should be the goal of Phase II.

A89-067 TITLE: The Relationship between Experience Factors and Rapid Tactical Decision Making

DESCRIPTION: The objective of Phase I will be to develop and detail a testable theory of the relationship between various military experience factors such as knowledge of weapon and support systems, of enemy capabilities and doctrine, of tactical principles, of military history, etc., plus types of practical experience in applying these and the ability to make reasonable tactical decisions within the time and information constraints imposed by the modern battlefield. This will be a theory of military tactical decision-making expertise with hypothesis that can be tested either in the laboratory, the classroom, or in field exercises. The products of the Phase I effort will be-

- A literature review of causal factors and theories of decision-making expertise in general with emphasis on that literature applicable to military tactical decision-making.

- A theory of military tactical decision-making expertise tied to the existing literature and to information gained from tactical decision-making experts. The theory will include concrete, testable hypothesis, and a logical plan of research extended to create an empirical evidence base for the theory and demonstrate it’s application to military training and command and control systems and organization.

Phase II will consist of execution of the research plan developed in Phase I, or that portion of the plan that can be executed within the available resources. The end product of Phase II will be specific recommendations based upon empirical evidence and sound theoretical principles that can be used by the Army to improve tactical decision-making quality and timeliness. These recommendations can concern the training of decision makers, the organization of staffs for decision-making, or means of supporting the decision-making process. The products of the Phase II effort will be-

- A technical report of the basis, conduct, and result of each experiment or set of related experiments performed under Phase II. It is estimated that between two and four such reports will be required.

- A final report that summarizes the Phase I and II effort and contains the recommendations mentioned above.

A89-068 TITLE: Techniques for Option Generation in Decision-Making

DESCRIPTION: Option generation is a critical part of decision-making and any improvement in option generation in military decision-making would yield high pay-offs. The basic research literature in decision-making contains examples of approaches to stimulate and assist option generation. These approaches should be cataloged, new approaches developed where appropriate, and the best approaches tested for feasibility pay-off. The best candidate approach should then be implemented as an automated decision aid. The objectives of Phase I will be to (1) review and analyze the literature in option generation in decision-making; (2) identify or develop two or more candidate aiding approaches or techniques for option generation; (3) experimentally test the candidate techniques; and (4) select one technique for implementation as an automated decision aid. Phase I products include a report documenting the results of the literature review, and a report documenting the experiment testing the candidate aiding techniques describing the aiding concept that is to be implemented.

The objectives of Phase II will be to (1) design an automated decision aid for course-of-action generation in tactical planning; (2) implement the design in a prototype aid, and (3) evaluate the prototype aid. Phase II products include a prototype decision aid to support option generation in G3 planning and a report documenting the evaluation of the prototyped aid.

A89-069 TITLE: Development of Methodology for Assessing the Effectiveness Of Command and Control (C2) Functions During User Testing

DESCRIPTION: A wide variety of automated systems used in the command and control process are currently being developed for use by the Army. Examples of such systems include Extended Position and Location Reporting System (EPLRS), the Maneuver Control System (MCS), and communication systems like Single Channel Ground and Airborne Radio System (SINCGARS), and Mobile Subscriber Equipment (MSE). In addition, computer technology is being used to develop various training devices that will be used in part to train command groups. A prominent example is Simulation Network (SIMNET).

Such systems must undergo user testing and evaluation before they are accepted by the Army. This is done to demonstrate that systems meet the Army's needs. Initially, a system undergoes operational testing (OT) to see how adequately it operates in an operational environment, and sometimes the system is also subjected to Force Development Test and Experimentation (FDT&E) in order to determine the best way to employ the system tactically and operationally.

One of the issues frequently addressed during the formal evaluation of a system in the extent to which a given system improves the command and control process. This has traditionally proven to be a rather difficult task to perform, and testers have typically relied on subjective impressions and ratings of commanders and their staff to provide information to address the issue. Objective performance data to address the issue to have seldom been collected.

There have been some attempts to develop more objective procedures for evaluating the effectiveness of command and control procedures. Examples include using Army Training and Evaluation Plans (ARTEPs), and the Headquarters Effectiveness Assessment Tool (HEAT). But these methods tend to be cumbersome and very manpower intensive, in addition to being of unknown reliability and validity.

There is thus a need for the development of a method for objectively measuring the effectiveness of command and control functions. The method should be applicable to evaluating (C2) functions at battalion, brigade, and division level during user testing and evaluation. Conservation of manpower on site during testing is important. Utilization of computer technology to collect and process objective performance data is highly recommended.

It should be noted that this problem is similar to evaluating (C2) during training of command groups, and nay method developed under this program will likely have applicability to evaluating training programs. The unique focus here, however, is on developing measures of (C2) that can be applied during user testing of systems under field conditions that stimulate a combat environment.

The work will be accomplished in two phases. The objectives of Phase I will be to (1) develop objective performance measures that can be used to evaluate the C2 effectiveness of command groups in maneuver battalions, maneuver brigades, and divisions, and (2) develop a plan for validating those measures. The deliverable will be a report that reviews previous work in the area, describes the performance measures developed for this effort, the rationale for their selection, and describes the performance measures developed for this effort, the rationale for their selection and development, and a proposed validation plan.

The objectives of Phase II will be to (1) validate the performance measures during a field test, (2) refine the measures as a result of the validation effort, and (3) revalidate the measures on another field test. The final report will fully describe the performance measures, the validation process, and the methodology for analyzing the measures.

MEDICAL RESEARCH AND DEVELOPMENT COMMAN D

A89-070 TITLE: Production Recombinant Flavivirus Antigens

DESCRIPTION: Recombinant antigens are needed for development of vaccines and diagnostics tests for 4 serotpes of dengue and Japanese encephalitis. Optimal expression systems, methods of purification, and methods of delivery are required.

A89-071 TITLE: Purification of Sub-Unit Vaccine Candidates

DESCRIPTION: Crude cell suspensions or lysate will be purified by appropriate techniques, such as chemical precipitation, centrifugation, column chromatography, and electophoresis so that immunogenic proteins at high specific activity may be used for biochemical an immunological tests as well as immunization of animal.

A89-072 TITLE: Development of a Tri-Enzyme Enzyme-Linked Immunosorbent Assays (ELISA) System

DESCRIPTION: Enzyme-Linked mmunosorbent Assays (ELISAs) are used to detect a wide variety of antigens and antibodies, e.g., microorganisms in blood. Most ELISAs are designed to detect only a single antigen even though tests for different antigens in the same sample are required. The development of a tri-enzyme ELISA system would permit the concurrent testing of a single sample for three different antigens, each being identified by the development of a different color in the ELISA plate. Development of this assay requires the identification of three enzyme-substrate systems which: (1) have similar optimum reaction parameters, e.g., pH; (2) develop different color products with different optimum absorbance wavelengths; and (3) have the required sensitivity. Such as system would have wide applicability and could reduce by as much as 60 percent assay time, required supplies and reagents, and associated costs.

A89-073 TITLE: Biological Assay of Candidate Antiparasitic Drugs

DESCRIPTION: Develop reliable and reproducible biological assays and models for assessment of antiparasitic activity of candidate drugs of diverse chemical classes. Parasitic diseases of importance are malaria, leishmaniasis and schistosmiasis, and the determination and evaluation of parasitic drug resistance is a principle concern. Methods should utilize techniques to accurately measure such parameters as exponential parasite growth rates, parasite survival, and the effects of antibiotics or antimetabolites. The acquisition of information about biochemical and molecular mechanisms of drug action and resistance would be a distinct advantage. Where possible, clones of human parasites with known drug susceptibility patterns should be used. The ultimate program objective is the development of new and effective curative and prophylactic antiparasitic disease drugs.

A89-074 TITLE: Synthesis of Potential Antiparasitic Diseases Drugs

DESCRIPTION: The objectives are the design and synthesis of new chemical compounds as potential drugs against malaria and other parasitic disease. Proposed compounds are to be prepared in sufficient quantities for in vitro and in vivo testing (about 3 grams each), and submitted to the USAMRDC for biological evaluation. Sufficient examples of the proposed compounds are to be prepared under Phase I to evaluate the area (class of compounds) and only those demonstrating biological activity in the test system utilized will be considered for further development (Phase II). Phase II objective is the further development of active compounds and/or chemical class of compounds.

A89-075 TITLE: Synthesis of Potential Anti-Chemical Warfare (CW) Agents

DESCRIPTION: The objectives are the design and synthesis of new and novel chemical compounds as potential anti-chemical warfare agents, especially for vesicants (sulfur mustard and cyanide). Proposed compounds are to be prepared in sufficient quantities for in vitro testing and are to be submitted to USAMRDC for biological evaluation. Sufficient examples of the proposed compounds are to be prepared under Phase I to evaluate the area (class of compounds) and only those demonstrating biological activity in the test systems utilized will be considered for further development (Phase II). Phase II objective is the further development of active compounds and/or chemical class compounds.

A89-076 TITLE: Nozzle Assembly for Army Mass Delousing Outfit

DESCRIPTION: A requirement exists to dispense a metered amount of insecticide during mass human delousing operations. A nozzle assembly capable of dispensing 2-4 grams of talcum powder per shot needs to be developed. The gun must be powered by a Kioritz Model DM-9 backpack sprayer.

A89-077 TITLE: In Vitro Dermal Toxicity Screening Tests

DESCRIPTION: Phase I: Develop short-term in vitro dermal toxicity screening tests for Army-relevant chemicals utilizing human cells. Phase I Product: Report describing screening test methodologies. Phase II: Perform validation studies on the screening tests to establish accuracy and precision in detecting potential dermal toxicants. Phase II Product: Report describing the results of the validation studies on the screening test.

A89-078 TITLE: In Vitro Respiratory Toxicity Screening Tests

DESCRIPTION: Phase I: Develop permanent functionally differentiated rodent and/or human cell lines derived from respiratory tissue for use in short-term in vitro respiratory toxicity screening tests for Army-relevant chemicals. Phase I Product: Report describing methods for production of cell lines. Phase II: Develop short-term in vitro respiratory toxicity screening tests utilizing cell lines developed in Phase I; perform preliminary validation studies on the screening tests to establish their accuracy and precision in detecting potential respiratory toxicants. Phase II Product: Report describing methods for screening tests and the results of the validation studies.

A89-079 TITLE: Characterizing Soldier Responses to Irritant Gases

OBJECTIVE: Provide a quantitative definition of soldier performance degradation resulting from exposure to irritant gases from guns and rockets.

DESCRIPTION: Irritant gases (HC1, NH3, formaldehyde, etc.) associated with weapon systems exhaust emissions are known to produce performance decrements under certain circumstances. Evaluation of soldiers' response to irritation stimuli resulting from exposure to these gases is complicated by the variability of duration of the exposures at a given concentration, by the intermittence of exposures, and acclimation of them, and by ambiguities in the definition of a performance decrement. The research should use an innovative approach to derive a useful

quantitative definition of human performance degradation in response to irritant gases and should address the problems associated with using animal tests to predict performance effects in humans. It should also provide a practical demonstration of responses to exposure to one or more irritant gases, using animal and human tests to evaluate the relationship of responses that affect the ability to perform military tasks to the concentration of the gas and the duration of exposure. Phase II of the project should validate the performance degradation model with more extensive tests using additional irritant gases and should evaluate the effects of acclimation, tolerance, and intermittent repetitive exposures upon performance.

A89-080 TITLE: Diagnosis of Natural and Induced Diseases of Military Importance

DESCRIPTION: This effort is designed to provide state-of-the-art technology to develop a system for rapid identification and diagnosis of agents or diseases acquired naturally or by exposure to biological weapons. The system will provide for rapid identification of agents/diseases through examination of clinical specimens such as blood, urine, spinal fluid and throat washings. The system should be extremely sensitive, using very specific reagents such as monoclonal antibodies prepared through hybridoma technology. There is interest in production of both monoclonal antibodies, and development and production of synthetic polypeptides for use as immunogens. Methods utilizing the latest in biotechnology techniques should be utilized, such as labeled molecular probes for the identification and analysis of microbes or their products.

A89-081 TITLE: Vaccine Delivery Systems

DESCRIPTION: A requirement exists for immunization methods to include controlled-release systems, carriers, and/or adjuvents compatible with live, attenuated and/or killed vaccines. Requirement is to achieve a high degree of protective immunity with multiple products in a short period of time with a minimum requirement for multiple does or booster immunizations. Special emphasis is on development of mucosal immunity.

A89-082 TITLE: Immunoassays and Therapy for Low Molecular Weight Toxins

DESCRIPTION: Development of rapid identification and diagnostic methods for the assay of toxins, metabolites, and analogs. Development of pharmacological therapy that is potentially safe for man following exposure. Therapy should minimally be effective prophylactically but preferably efficacious after exposure. Production of research quantities (100 – 1,000 mg) of toxins noted below. Toxins of major interest include low molecular weight protein and non-protein toxins such as algal toxins (microcystin, anatoxin A, saxitoxin, gonyautoxin, ciguatoxin, maitotoxin, brevetoxin, palytoxin, lyngbyatoxin, debromoaphlysiatoxin), vertebrae toxins, (tetrodotoxin, batrachotoxin) and protein and peptide toxins of other biological origin, including pre- and postsynaptic neurotoxins, protein synthesis inhibitory toxins and membrane active substances. There is no interest in the trichothecene mycotoxins.

A89-083 TITLE: Ocular Protection from Laser Hazards

DESCRIPTION: A requirement exists to provide ocular protection to troops at risk from laser energy exposure and ballistic fragments. The US Army is interested in research and development to improve concepts, devices, and mechanisms that offer substantial ocular protection from multiple laser wavelengths without degrading essential visual performance. Techniques developed should be adaptable to standard spectacle, goggle, and visor configurations. End items should be resistant to abrasion and impact from ballistic fragments.

PHASE I - Identify a viable concept or device with sufficient laboratory data to demonstrate feasibility.

PHASE II – Further develop the concept of device and deliver a device for Government testing.

A89-084 TITLE: High Duty Cycle, High Power X-Ray Tube for Medical Imaging

DESCRIPTION: Present x-ray tube technology being used for combat medical imaging is a variation of conventional solid rotating anode design. Combat trauma imaging requires a high duty cycle tube. Heat unit overload is a major consideration. Accordingly, we are seeking improved design and engineering remedies for development of a high-heat-load, high-power combat x-ray tube to be used in radiographic fluoroscopic and computer tomography devices.

ISC-ARMY INSTITUTE FOR RESEARCH IN MANAGEMENT INFORMATION, COMMUNICATIONS, AND COMPUTER SCIENCE

A89-085 TITLE: Distributed System Simulation Performance Improvements Through New Algorithmic Modeling & Hardware Architectures

DESCRIPTION: This research involves the use of parallel processors or transputers to simulate distributed system environments. The first step in building the model would involve developing simulations, or emulations where possible, of all the resources in the environment to be modeled. Each of the corresponding simulations of these resources will be mapped onto a separate process on the parallel processor so that it can be run concurrently with any of the other simulations. With this system, a high level of accuracy will be possible, with the data being collected in a real or hyper time.

The first phase of this research will develop the structure of the algorithms that would make up the parallel processor distributed system model, collect or develop the necessary simulations of resources to describe a potential distributed system environment, and demonstrate the functionality of the above model. The second phase will develop the model to the point that highly accurate simulations of large distributed systems can be performed.

A89-086 TITLE: Decision Making In A Geographically Distributed Environment

DESCRIPTION: Decision-making does not occur in isolation. Rather, decision-making is a highly interactive process involving idea sharing, and the identification of constraints, relationships, and alternatives. In the Army, groups of individuals provide information and participate in the process leading to the final decision. Decision Support Systems (DSS) or decision aids have been built to help individuals in the decision process, and work has been conducted to help groups of decision-makers that are co-located. Very little has been done to support groups of decision-makers that are geographically distributed. The increased availability of computer networks opens new opportunities for the support of this process with Group Decision Support Systems (GDSS). Research needs to be conducted that will utilize the computer-networking environment in innovative ways to increase the quality and speed of decisions made by distributed decision-makers. In Phase II of this project, the Phase I results would be applied to a real Army problem which contains geographically distributed decision-makers.